Claims

We claim:

1   1. A method for determining correspondence between locations on a display

2   surface having an arbitrary shape and pixels in an output image of a

3   projector, comprising:

4   projecting a set of known calibration patterns onto the display surface;

5   sensing directly an intensity of light at each of a plurality of locations

6   on the display surface for each calibration pattern, there being one discrete

7   optical sensor associated with each location; and

8   correlating the intensities at the locations to determine

9   correspondences between the plurality of locations and pixels in an output

10   image of the projector.

1   2. The method of claim 1, in which each location has known coordinates.

1   3. The method of claim 1, in which the calibration patterns are in a form of

2   Gray codes.

1   4. The method of claim 1, in which the correspondences are used to

2   determine parameters of the projector.

1   5. The method of claim 4, in which the parameters include internal and

2   external parameters and non-linear distortions of the projector.

1   6. The method of claim 1, further comprising:

2   warping an input image to the projector according to the

3   correspondences; and

4   projecting the warped input image on the display surface to appear

5   undistorted.

1   7. The method of claim 1, in which the projector is casually aligned with the

2   planar display surface.

1   8. The method of claim 1, in which the display surface is planar.

1   9. The method of claim 1, in which the display surface is quadric.

1   10. The method of claim 1, in which a viewer and the projector are on a

2   same side of the display surface.

1   11. The method of claim 8, in which the display surface is planar and a

2   number of locations is four.

1   12. The method of claim 1, in which the optical sensor is a photo transistor.

1   13. The method of claim 12, in which the optical sensor is coupled to the

2   corresponding location by an optical fiber.

1   14. The method of claim 1, in which the intensity is quantized to zero or one.

1   15. The method of claim 1, further comprising:

2   warping a sequence of input images to the projector according to the

3   correspondences; and

4   projecting the warped sequence of input image on the display surface

5   to appear undistorted as a video.

1   16. The method of clam 15, in which the display surface and the projector

2   are moving with respect to each other while determining the

3   correspondences, warping the sequence of images, and projecting the

4   warped sequence of input images.

1   17. The method of claim 1, in which the display surface is an external

2   surface of a 3D model of a real-world object.

1   18. The method of claim 1, in which the display surface includes a backdrop

2   on which the 3D model is placed.

1   19. The method of claim 1, in which the light is infrared.

1   20. The method of claim 1, in which each calibration image is projected as a

2   pair, a second image of the pair being an inverse of the calibration image.

1   21. The method of claim 1, in which the correspondences are used to

2   relocate the projector.

1   22. The method of claim 1, in which the correspondences are used to deform

2   the display surface.

1   23. A system for determining correspondence between locations on a display

2   surface having an arbitrary shape and pixels in an output image of a

3   projector, comprising:

4   a display surface having a plurality of locations with known

5   coordinates;

6   a plurality of known calibration patterns;

7   means for sensing directly an intensity of light at each of the plurality

8   of locations on the display surface for each calibration pattern; and

9   means for correlating the intensities at the locations to determine

10   correspondences between the plurality of locations and pixels in an output

11   image of the projector.

1   24. The system of claim 24, in which each location is optically coupled to a

2   discrete photo sensor by an optical fiber.

1   25. The system of claim 24, in which the optical fiber is located in a

2   throughhole in the display surface.

1   26. A method for determining correspondence between locations on a

2   display surface having an arbitrary shape and pixels in an output image of a

3   projector, comprising:

4   sensing directly an intensity of light at each of a plurality of locations

5   on a display surface for each of a plurality of calibration patterns projected

6   on the display surface, there being one discrete optical sensor associated

7   with each location; and

8   correlating the intensities at the locations to determine

9   correspondences between the plurality of locations and pixels in an output

10   image of the projector.